TagMe: An Easy-to-Use Toolkit for Turning the Personal Environment into an Extended Communications Interface

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Abstract
In this paper we present an end-user toolkit for easy creation of responsive objects and environments. TagMe consists of a wearable device that recognizes the object or surface the user is touching. The user can make everyday objects come to life through the use of RFID tag stickers, which are read by a RFID bracelet whenever the user touches the object. We present a novel approach to create simple and customizable rules based on emotional attachment to objects and social interactions of people. Using this simple technology, the user can extend their application interfaces to include physical objects and surfaces into their personal environment, allowing people to communicate through everyday objects in very low effort ways. This paper discusses different applications for this type of technology as well as the implementation of the bracelet prototype and the supporting smartphone application.

Author Keywords
Wearable Device; Surface Interaction; Intuitive Interfaces; User-centered design; Low-effort

interaction; Ubiquitous Computing; Smart Environments.

ACM Classification Keywords
H.5.2 User Interfaces: Graphical user interfaces, Input devices and strategies, Interaction styles, Natural language, Prototyping, Screen design, Training, help and documentation, User-centered design; H.4.3 Communications Applications: Electronic Mail.

Introduction

In daily life, people interact with their entire physical environment using all of their senses. However, when it comes to the digital world, our interactions are restricted to an audiovisual experience and limited to the small screens of our computers and smartphones. UI researchers have been trying to overcome these limitations using a variety of approaches, ranging from projected interfaces [1] [3] to tangible interfaces [2] [4]. The TagMe project attempts to make it easy and convenient for end users to extend their interfaces to the objects and surfaces around them. What is different in our approach is we combine the idea of social awareness systems with ubiquitous computing, wearable devices and RFID tagged objects. Thereby, it becomes easy for people to build systems to stay in touch with others in low effort ways.

The system consists of three things: (1) an unlimited supply of small and cheap RFID stickers which can be used to tag objects or surfaces, (2) an RFID reading bracelet with connection to the user's smartphone and (3) a software application on the smartphone (Figure 1). The tags, reader and software are used to create interfaces in our physical environment to communicate with others or automate simple actions.

People often have an emotional attachment to the objects around them [20]. For instance, an object may remind us of the person who gave it to us. If we collected the object at a meaningful time in our life, the use of the object might bring back special memories. TagMe can be used to augment such objects so that every time the user touches the object, a special action is taken. For example, every time I use the purse, which was a present from a friend, that same friend is sent a message telling her I am enjoying her gift. Similarly, TagMe can be used to create interfaces in our physical environment for routine actions. If I wish I had a more convenient switch to turn off the lights from my bed, I can just add a sticker to the headboard of the bed which when read by the bracelet will turn on/off the lights.

Figure 1. Devices involved on TagMe system.

Figure 3. Feedback provided after detecting a tag: LED and smartphone popup.

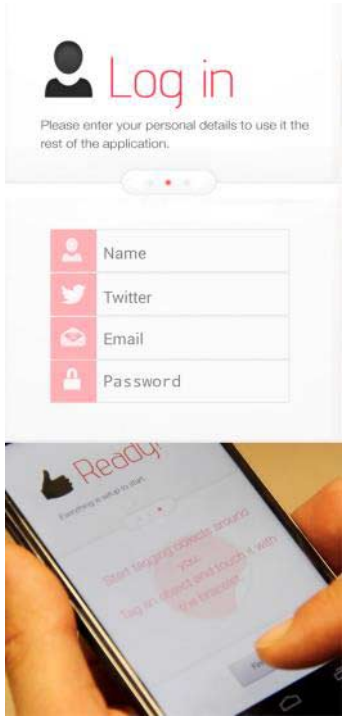

Figure 4. A user configures and logs into the application.

Related Work

The work related to TagMe falls into two classes. First, there is the recent surge of commercial electronic bracelets [6]. Some of the applications that are supported by these bracelets include monitoring daily exercise [5], medical conditions [7] or social awareness [8][9]. Unlike TagMe, commercial bracelets typically only support a fixed, predefined set of applications.

A second category of related work is the research projects that make use of RFID tags and mobile devices. One project closely related to TagMe is ReachMedia [10], an RFID bracelet that offers just-in-time information during a shopping experience. A project by Jukka [19] connects visual symbols (RFID tagged) to activate a service when the user reads one of the tags using his mobile phone. Each tag offers a preconfigured service for all the end-users of the system.

RFID technology has also been used to track objects [11][12] or actions of the wearer. Some example applications are OnObject [13], a ring that programs toys using gestural movements and RFID tags and RFIDGlove [14], a system that recognizes actions performed by the wearer in order to increase the efficiency of work patterns. In shopping experiences, the fitting rooms have been equipped with RFID readers that detect each piece of clothing and provide recommendations to the user [15].

The information provided by real objects is limited by their intrinsic characteristics. In Roy Want's pioneering research, RFID technology was used to create interfaces that extend the physical limitations of everyday objects with virtual content [16] or with RFID sensors [17]. QueryLens [18] is another related project, which uses RFID tags to identify objects and enable users to share information about those objects in the form of FAQ lists.

TagMe differs from all of the project mentioned above by (1) being focused on easy use and creation of rules by an end-user and (2) by being focused on enabling the creation of personally meaningful social and emotional interactions in the user's personal environment.

Interactions Supported

The TagMe system supports two types of interactions: "read" and "not read". A user can specify an action that will be triggered whenever the bracelet reads the tag. Some example actions that may be triggered are different types of notifications such as sending a Tweet, SMS or a Facebook message (Figure 2). We provide feedback to the user using a LED (Light-Emitting Diode) on the bracelet as well as a notification sound and vibration on the smartphone (Figure 3).

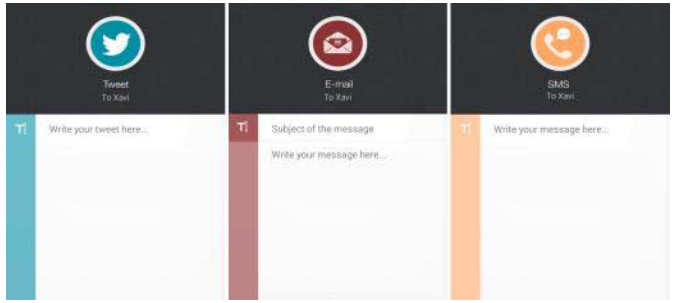

Figure 2. Screens to write a tweet, an email or a SMS.

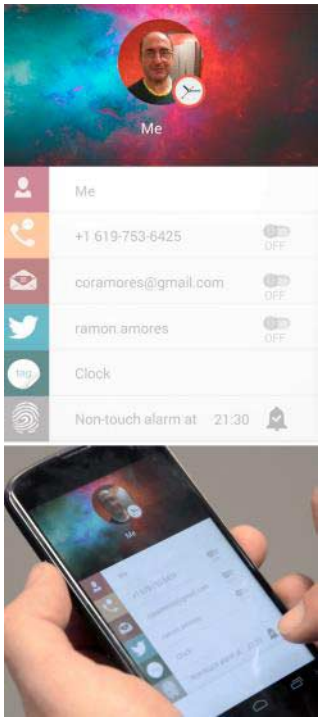

Figure 5. A user configures a tag on the smartphone application and sets the alarm of "not read".

A second type of interaction that is supported is the "not read" interaction. If the user does not touch a certain tagged object within a particular time frame, an action will be taken. This type of interaction is used to create notifications or alarms to remind the user to do certain things. For example, a user can attach an RFID sticker to the bottle of some prescription drug that she has to take every morning and instruct the system to send an alert to herself if that tag is not read between 7am and 8am each day.

Operation Instructions

TagMe consists of a bracelet, a smartphone application and RFID stickers that we call "tags" (Figure 1). If the user is using the application for the first time, he has to log into the application and the system will be ready to use (Figure 4). At this point RFID tags can be stuck onto objects or surfaces and configured to be used as an interface. The first time the bracelet reads a tag, the user has to instruct the system on what action has to be taken whenever that tag is read or not read. The user has to specify a message to be sent, a means to send it (Twitter, Email, SMS or a Facebook message) and an addressee (Figure 5). To ensure ease of use, the addressee information is obtained from the user's contact list. The application provides a button to clear old tags; activate/deactivate different types of messages (Figure 5) and a variety of feedback the first time the user touches a tagged object (Figure 3).

Implementation

In order to develop TagMe, we designed and created a 3D-printed bracelet, shown in Figure 2. We also implemented an Android Application that interfaces with Facebook, Twitter, Email and SMS (Short Message Service).

We used the ABSplus material to 3D print the bracelet. We placed the electronic components on one half of the bracelet, and the battery on the other half. The two halves of the bracelet are connected using a magnetic closing system that is attracted or rejected depending on the battery polarity. We use the magnets to transfer the power from the battery to the electronics and to provide a safe closing system.

To endow the bracelet with the communication capability between the application and RFID tags, we used different types of electronic components (Figure 6). One of our goals was to make the bracelet as small and lightweight as possible so as to be comfortable being worn on the wrist all day (and night). We therefore used the smallest RFID Reader on the market, the SkyeModule™ M1-Mini TTL that works at 13.56 Mhz and offers a 4 cm operation range that allows us to detect if the bracelet is proximal to the tagged object. An ATmega 168 microprocessor controls the whole system, and a Bluetooth RN-41 implements the wireless communication with the smartphone. We use a 3.7V polymer Lithium-ion battery in order to provide power to the electronics components of the bracelet.

Usage Scenarios

TagMe can be used in a variety of applications most of them related to health, personal relationships and home automation. All the scenarios presented below are based on the "read" and "not read" interactions and are able to send and receive information through Twitter, E-mail, Facebook and SMS.

- *Health:* In the field of health and wellbeing, TagMe can be useful to help people who have to take pills

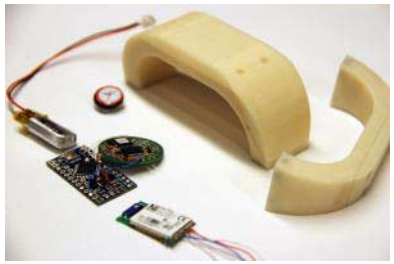

Figure 6. Electronic components and 3D printed bracelet.

Figure 7. TagMe detects when a pet is eating and sends a notification to the owner.

Figure 8. The user is touching her picture and the system is sending a notification to her contact.

every day. The system can check if a person forgets to take their pills, and in case it was forgotten (the tag is not read), TagMe sends a message directly to one or more relevant people including the patient and caregivers. This might be especially useful for people with dementia or memory issues.

- *Social:* Objects remind us of things, people and places we care about. TagMe can be used to stay in touch with friends and relatives. Everytime you touch a present that someone gave to you, a notification will be sent to that person. Similarly, loved ones can be kept in touch at a high level of the actions of a family member (Figure 8). For example a working parent may choose to receive a message when their kid gets home after school.
- *Motivation:* Being motivated is essential in daily life. TagMe can be used to encourage people to get exercise or focus on work. The system can remind us about what we should do in our everyday life to achieve our objectives, for example, visiting the gym or encouraging us not to open the cookie jar if we are on a diet.
- *Emergencies:* Tagme can be used to create convenient "emergency" buttons, such in a car accident sending a notification directly to 911 touching the RFID tag.
- *Logging behavior:* TagMe can be used to log behavior of people or animals. For example, by using a tag on a food figure bowl, it can monitor the feeding behavior of a pet, so that every time the animal eats, the owner will receive a notification (Figure 7).

Evaluation

As an initial evaluation, seven people of varying ages were asked to configure the bracelet and report all the ways they would like to use it. According to their comments we can verify that the interest of the users vary depending on their age and their habits. The ones who are owners of pets considered interesting to monitor the animal far from home, the older ones (68f, 72f, 54m) said that they would like to use it as a reminder for drug prescription and emergencies for themselves and for their family. In contrast, the youngest people (49f, 34m, 22m, 19f) answered they would like to use it for personal motivation and social interactions.

We received positive feedback from all the users; especially they were surprised by the simple and comfortable way of sending messages through stuck tags on objects. Some of them suggested the idea of drawing on the stickers in order to remind what the tag does. Two of them mentioned they liked the closing magnetic system and they would make the bracelet more flexible, even one of them encourage us to integrate it on a smart watch.

Future Work

In future work we plan to extend TagMe so users can define rules that have to be taken when a sequence of tags has been read (or not read). In terms of the design, we are exploring different materials such rubber to build a more comfortable and thin bracelet that would fit better on the user's wrist. Among other things, we would like to explore the possibilities of other types of wearable devices such as rings, necklaces or fake fingernails. In order to improve the detection range of the bracelet, we are working on a bigger antenna to increase the read distance of the

RFID tags. Finally, in terms of applications, we plan to study whether TagMe can improve the independence and well being of people with memory problems (such as dementia and Alzheimer patients).

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References

[1] Claudio S. Pinhanez. "The Everywhere Displays Projector: A Device to Create Ubiquitous Graphical Interfaces." In Proc. UbiComp 2001, p.315-331.

[2] Hiroshi Ishii, Brygg Ullmer. "Tangible bits: towards seamless interfaces between people, bits and atoms", In Proc. of the CHI 1997.

[3] Pranav Mistry, Pattie Maes. "SixthSense: a wearable gestural interface", ACM SIGGRAPH ASIA 2009 Sketches.

[4] Scott Brave, Andrew Dahley. "inTouch: a medium for haptic interpersonal communication". Ext. abstracts on CHI '97, p.363-364.

[5] Nike+ FuelBand http://www.nike.com/us/en_us/c/nikeplus-fuelband

[6] Jawbone http://jawbone.com

[7] L. Angelini, M. Caon, S. Carrino, L. Bergeron, N. Nyffeler, M. Jean-Mairet, E. Mugellini. "Designing a Desirable Smart Bracelet for Older Adults". InProc. Of UbiComp'13.

[8] A. Williams, S. Farnham , S. Counts. "Exploring wearable ambient displays for social awareness", Ext. Abstracts of CHI '06.

[9] P. Ahde, J. Mikkonen. "Hello: bracelets communicating nearby presence of friends, In Proc. of the Tenth Anniversary Conference on Participatory Design 2008.

[10] A. Feldman, E. Munguia Tapia, S. Sadi, P. Maes, C. Schmandt. "ReachMedia: On-the-move interaction with everyday objects", In Proc. of the ISWC 2005, p.52-59.

[11] K.P. Fishkin, M. Philipose, and A. Rea, "Hands-on RFID: wireless wearables for detecting use of objects," In Proc. of the ISWC 2005, p. 38-41.

[12] M. Buettner, R. Prasad, M. Philipose , D. Wetherall. "Recognizing daily activities with RFID-based sensors", In Proc. of the UbiComp 2009.

[13] K. Chung, M. Shilman, C. Merrill, H. Ishii. "OnObject: Gestural Play with Tagged Everyday Objects". In Proc. of UIST'10.

[14] Muguira, L.; Vazquez, J.I.; Arruti, A.; de Garibay, J.R.; Mendia, I.; Renteria, S. "RFIDGlove: a Wearable RFID Reader". In Proc. of ICEBE'09.

[15] J. Melià-Seguí, R. Pous, A. Carreras, M. Morenza-Cinos, R. Parada, Z. Liaghat , R. De Porrata-Doria. "Enhancing the shopping experience through RFID in an actual retail store", In Proc. of the UbiComp 2013.

[16] R. Want, K. P. Fishkin, A. Gujar , B. L. Harrison. "Bridging physical and virtual worlds with electronic tags", In Proc. of the CHI 1999, p.370-377.

[17] R. Want. "Enabling ubiquitous sensing with RFID," Computer, vol. 37, pp. 84-86, 2004.

[18] Shin'ichi Konomi. "QueryLens: Beyond ID-Based Information Access, In Proc. of the UbiComp 2002, pp.210-218.

[19] Jukka Riekki, Timo Salminen , Ismo Alakarppa. "Requesting Pervasive Services by Touching RFID Tags", IEEE Pervasive Computing, v.5 n.1, p.40-46, January 2006

[20] John Bowlby. *A Secure Base: Clinical Applications of Attachment Theory*. Taylor & Francis, 2005.